

ACCELERATOR DIVISION ADMINISTRATIVE PROCEDURE

ADAP-11-0001

STARTUP OF THE ACCELERATOR COMPLEX AFTER A MAJOR SHUTDOWN

RESPONSIBLE DEPARTMENT : ADHQ/SYSTEMS

PREPARED BY Vk Bharadwaj DATE 7/27/93
Vinod Bharadwaj
Associate Accelerator Division Head, Systems


APPROVED BY S.D. Holmes DATE 8/5/93
Steve Holmes
Accelerator Division Head

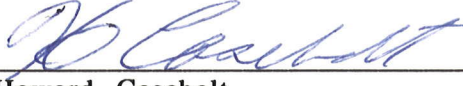
REVISION NO. 0 REVISION ISSUE DATE 8-11-93

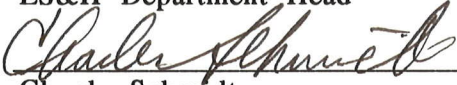
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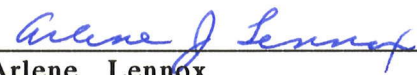
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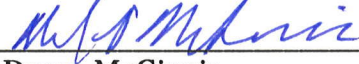
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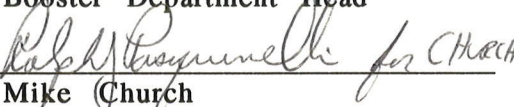
REVIEWED BY:  DATE: 7-22-93
Bob Mau
Operations Department Head


REVIEWED BY:  DATE: 7/22/93
Howard Casebolt
ES&H Department Head


REVIEWED BY:  DATE: 7-22-93
Chuck Schmidt
Linac Department Head

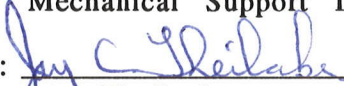
REVIEWED BY:  DATE: 7-22-93
Arlene Lennox
NTF Department Head

REVIEWED BY:  DATE: 7-26-93
Dave McGinnis
Booster Department Head

REVIEWED BY:  for CHACH DATE: 7/22/93
Mike Church
Antiproton Source Department Head

REVIEWED BY:  DATE: 7/29/93
John Marriner
Main Accelerator Department Head

REVIEWED BY:  DATE: 7-22-93
Mike May
Mechanical Support Department Head

REVIEWED BY:  DATE: 7-22-93
Jay Theilacker
Cryogenics Department Head


REVIEWED BY:  DATE: 8/4/93
Dan Wolff
Electrical Engineering Support
Department Head

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1.0 PURPOSE AND SCOPE

The purpose of this procedure is to describe the way that the Fermilab Accelerator complex is turned back on after the extended shutdowns that occur between running periods. Typically the shutdowns are greater than a month long, the Tevatron is warmed up to either room or to liquid nitrogen temperatures and extensive accelerator maintenance and improvement work has taken place. This procedure does not address the short, very tightly controlled shutdowns that occur during the course of a run for maintenance and repair of specific components.

1.1 POLICY

It is the Accelerator Division Policy that beam will not be introduced into any accelerator until

a. equipment and components are configured in a manner to safely allow acceleration of beam.

b. operational beam limits have been established consistent with the requirements of the safety envelope contained in the current Safety Assessment Document for the Accelerator Complex.

2.0 RESPONSIBILITIES

2.1 AD ASSOCIATE DIVISION HEAD FOR SYSTEMS

The AD Associate Division Head for Systems is responsible for preparing this document and updating it on an as needed basis.

2.2 AD DEPARTMENT HEADS

All department heads are responsible for ensuring that the provisions relevant to their department are carried out. In the event of a change in departmental procedure that affect accelerator startup the AD department heads are responsible for ensuring that the AD Associate Head for Systems is informed. In addition the AD Department Heads (or their designees) have to sign-off on the relevant restart sheets and checklists.

2.3 AD DIVISION HEAD

The AD Division Head is responsible for approving this document and for overseeing that its provisions are carried out. The AD Division Head has to review and sign-off on the relevant restart sheets and checklists. The AD Division Head is responsible for sending the memos to the Operations Department Head to permit restart of the various systems.

The AD Division Head is also responsible for designating a major shutdown. Such a designation is accomplished by a memo to the AD Operations Department Head rescinding authorization to introduce and accelerate beam in the accelerator complex until re-authorized in writing as described in this procedure.

3.0 ACCELERATOR STARTUP PROCEDURE

3.1 ACCELERATOR COMPLEX

The Accelerator Complex consists of the Linac, Booster, Antiproton Source, Main Ring, Tevatron and Switchyard systems. Each of these systems are relatively self contained in terms of work that is done during shutdowns and in terms of power-up. Obviously beam can only be run in a particular machine if the systems upstream are operational.

3.2 BEAM PERMITS

During a run there is a beam permit for each of the accelerator systems (an example of one is given in attachment 1). These permits are usually created before the beginning of a run and indicate the maximum beam power allowed in the appropriate accelerator system. The beam power limits are decided by the Division Head in consultation with the Fermilab Program Office. Under no circumstances will a beam permit allow operations at a level exceeding the Safety Envelope included in the current Safety Assessment Document. In general the operational beam permit limit will be less than or equal to 90% of the Safety Envelope limit. Beam permits are approved by the AD Operations Department Head, the AD Systems Department Head for the accelerator in question, the AD Associate Head for Systems and the AD Division Head. These permits are read and signed by the Operations Department Crew Chiefs to indicate that they have understood the beam power limits and are posted in the AD Main Control Room.

The complete list of beam permits are

- a. Linac Beam Permit
- b. NTF Beam Permit
- c. Booster Beam Permit
- d. Antiproton Source Beam Permit
- e. Main Ring Beam Permit
- f. Tevatron Beam Permit
- f. Switchyard Beam Permit

3.3 SIGN-OFFS & CHECKLISTS

The complete list of sign-off and checklists needed for this procedure are

- a. Accelerator System Restart Sign-off (see attachment 2)
- b. AD Mechanical Support Department Procedure ADDP-ME-0101
"Mechanical Support Department Quality Assurance Sign-off for Maintenance and Upgrade Tasks on the Accelerator Complex"
- c. AD Cryogenics Department Procedures
 - ADDP-CR-9203 "Cryogenic Checklist Following Cold Tevatron Component Change Procedure"
 - ADDP-CR-9204 "Cryogenic Checklist Following Cold Proton Bend Component Change Procedure"
 - ADDP-CR-9205 "Cryogenic Checklist Following Cold Muon Bend Component Change Procedure"
 - ADDP-CR-9206 "Cryogenic Checklist Following Cold Meson Bend Component Change Procedure"

- d. AD EE Support Department Procedures
 - ADDP-EE-4011 "TEV QPM End of Shutdown Start-up Procedure"
 - ADDP-EE-4013 "Low Beta QPM End of Shutdown Start-up Procedure"
 - ADDP-EE-4014 "Low Beta 1 kA Quad End of Shutdown or End of Repair Start-up Procedure"

Before an accelerator system can be powered and accept beam, an Accelerator System Restart Sign-off (see attachment 2) has to be completed and signed. This form requires the signatures of the appropriate department heads responsible for the system and the work done on it during the shutdown. By their signature they are indicating that the work was indeed completed and that to their knowledge the system is ready to be powered and accept beam. In addition the signature of the department head responsible for a particular system indicates that the radiation shielding for the system is configured as described in the current shielding assessment. For the Tevatron the mechanical, cryogenic and electrical walk-through checklists (as outlined in the above Mechanical Support, Cryogenic and EE Support Departments procedures) have to be completed before those department heads will sign the Accelerator System Restart Sign-off for the Tevatron. For the restart sign-off and the walk-through checklists the AD Division Head is ultimately responsible for ensuring that the appropriate persons have signed off and that the information on which the sign-offs rest is accurate.

3.4 SYSTEM TURN-ON

3.4.1 Linac

Before the Linac can be powered and accept beam, the Accelerator System Restart Sign-off sheet must be completed for the Linac to ensure that the work necessary for safe operation of the Linac has been completed.

Linac startup is initiated by a memo that is sent by the AD Division Head to the AD Operations Department Head indicating that it is ready for power-up and/or beam transport. The memo will also indicate the maximum beam power that can initially be run through the Linac. If this beam power is not that given in the Linac beam permit, the conditions that will have to be fulfilled before the beam permit become fully operational are included in the memo.

3.4.2 NTF

Before NTF can be powered and accept beam, the Accelerator System Restart Sign-off sheet must be completed for NTF to ensure that the work necessary for safe operation of NTF has been completed.

NTF startup is initiated by a memo that is sent by the AD Division Head to the AD Operations Department Head indicating that it is ready for power-up and/or beam transport. The memo will also indicate the maximum beam power that can initially be run through NTF. If this beam power is not that given in the NTF beam permit, the conditions that will have to be fulfilled before the beam permit become fully operational are included in the memo.

3.4.3 Booster

Before the Booster can be powered and accept beam, the Accelerator System Restart Sign-off sheet must be completed for the Booster to ensure that the work necessary for safe operation of the Booster has been completed.

Booster startup is initiated by a memo that is sent by the AD Division Head to the AD Operations Department Head indicating that it is ready for power-up and/or beam transport. The memo will also indicate the maximum beam power that can initially be run through the Booster. If this beam power is not that given in the Booster beam permit, the conditions that will have to be fulfilled before the beam permit becomes fully operational are included in the memo.

3.4.4 Antiproton Source

Before the Antiproton Source can be powered and accept beam, the Accelerator System Restart Sign-off sheet must be completed for the Antiproton Source to ensure that the work necessary for safe operation of the Antiproton Source has been completed.

Antiproton Source startup is initiated by a memo that is sent by the AD Division Head to the AD Operations Department Head indicating that it is ready for power-up and/or beam transport. The memo will also indicate the maximum beam power that can initially be run through the Antiproton Source. If this beam power is not that given in the Antiproton Source beam permit, the conditions that will have to be fulfilled before the beam permit becomes fully operational are included in the memo.

3.4.5 Main Ring

Before the Main Ring can be powered and accept beam, the Accelerator System Restart Sign-off sheet must be completed for the Main Ring to ensure that the work necessary for safe operation of the Main Ring has been completed.

Main Ring startup is initiated by a memo that is sent by the AD Division Head to the AD Operations Department Head indicating that it is ready for power-up and/or beam transport. The memo will also indicate the maximum beam power that can initially be run through the Main Ring. If this beam power is not that given in the Main Ring beam permit, the conditions that will have to be fulfilled before the beam permit becomes fully operational are included in the memo.

3.4.6 Tevatron

The Tevatron is a cryogenic magnet synchrotron and as such requires extra procedures for its turn on. These procedures are the mechanical and cryogenic walk-throughs that are required before the machine can be cooled down and the electrical walk-through that is necessary before the machine can be powered on. The following steps are taken.

walk-through procedures. The walk-through data is examined to ensure that all of the work was done properly and everything has been restored properly. At this point the walk-through procedure is signed off and permission can be given to initiate Switchyard cool down. This permission, with any conditions if necessary, is formally transmitted by a memo from the AD Division Head to the AD Operations Department Head. The permission can be verbally transmitted by the AD Division Head at the walk through meeting, but has then to be followed by the written memo within four hours.

b. Before the Switchyard can be powered and accept beam, the Accelerator System Restart Sign-off sheet must be completed for the Switchyard to ensure that the work necessary for safe operation of the Switchyard has been completed.

Switchyard beam startup is initiated by a memo that is sent by the AD Division Head to the AD Operations Department Head indicating that it is ready for power-up and/or beam transport. The memo will also indicate the maximum beam power that can initially be run through the Switchyard. If this beam power is not that given in the Switchyard beam permit, the conditions that will have to be fulfilled before the beam permit becomes fully operational are included in the memo

4.0 DOCUMENTATION

Copies of all beam permit authorization memos, Accelerator System Restart Sign-off forms, and beam power permit forms will be retained in the AD Documentation Center for a period of ten years. In addition the currently active beam power permit forms for all accelerator systems will be prominently displayed in the Main Control Room.

5.0 EXTRA-DIVISION DISTRIBUTION

- a. ES&H Section HQ
- b. Research Division HQ

BEAM PERMIT EXAMPLE



Antiproton Source Beam Safety Envelope

- The maximum hourly beam power transmitted by the Main Ring accelerator to the Antiproton production target is limited to that provided by 1800 pulses of 3×10^{12} protons per pulse at a kinetic energy of 120 GeV.
- The maximum hourly beam power transmitted by the Main Ring accelerator to the Antiproton source is limited to that provided by 360 pulses of 1×10^{11} protons per pulse at 8 GeV kinetic energy in any one hour.
- The maximum hourly beam power transmitted by the Booster accelerator to the Antiproton source is limited to that provided by 360 pulses of 1×10^{11} protons per pulse at 8 GeV kinetic energy in any one hour.
- No accelerator or beam line will transmit beam without an operational beam interlock safety system.

Antiproton Source Operating Beam Limits

- The maximum beam intensity transmitted by the Main Ring accelerator to the Antiproton target will be limited to 3×10^{12} protons per pulse.
- The maximum charge transmitted by the Main Ring to the Antiproton target will be limited to 5.1×10^{15} protons per hour at 120 GeV kinetic energy.
- The maximum beam intensity transmitted by the Booster or Main Ring to the Accumulator or Debuncher will be limited to 1×10^{11} protons per pulse.
- The maximum charge transmitted by the Booster or Main Ring to the Accumulator or Debuncher will be limited to 3.42×10^{13} protons per hour at 8 GeV kinetic energy.

Examples: Charge/hr = number of pulses/hr \times number of protons/pulse

- #1 1700 pulses per hour at 3×10^{12} protons per pulse to the target = 5.1×10^{15} protons/hr
- #2 2100 pulses per hour at 2.42×10^{12} protons per pulse to the target = 5.1×10^{15} protons/hr.
- #3 360 pulses per hour at 9.5×10^{10} protons per pulse to the Accumulator = 3.4×10^{13} protons/hr.
- #4 360 pulses per hour at 9.5×10^{10} protons per pulse to the Debuncher = 3.42×10^{13} protons/hr

Special conditions and comments:

Prepared By _____
Operations and Antiproton Source Department Heads/Date

Reviewed by _____
Associate Accelerator Division Head for Systems/Date

Approved by _____
Accelerator Division Head/Date

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Rev: 2/26/92



ACCELERATOR SYSTEM RESTART SIGN-OFF

The signatures below indicate that work done on the accelerator system since the last period of accelerator operation has been completed, and that the system are ready for restart. Signatures that are N/A should be initialed by the system Department Head.

SYSTEM BEING SIGNED OFF: _____

<u>DEPARTMENT</u>	<u>DATE</u>	<u>SIGNATURE (Department Head/Designee)</u>
CONTROLS	_____	_____
CRYOGENICS	_____	_____
EE SUPPORT	_____	_____
INSTRUMENTATION	_____	_____
MECH. SUPPORT	_____	_____
RF	_____	_____
ES&H	_____	_____
OPERATIONS	_____	_____

The _____ radiation shielding meets the requirements documented in the _____ shielding assessment.

Approved by _____
Department Head
Date

=====
 Comments and special conditions:

===== FINAL APPROVALS

Department _____
 Department Head _____ Date _____
 Accelerator Division Head _____ Date _____

